



Armed Forces College of Medicine AFCM



DEVELOPMENT OF GIT 3

**Development of the Midgut]
[and Hindgut**

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INTENDED LEARNING OBJECTIVES (ILO)



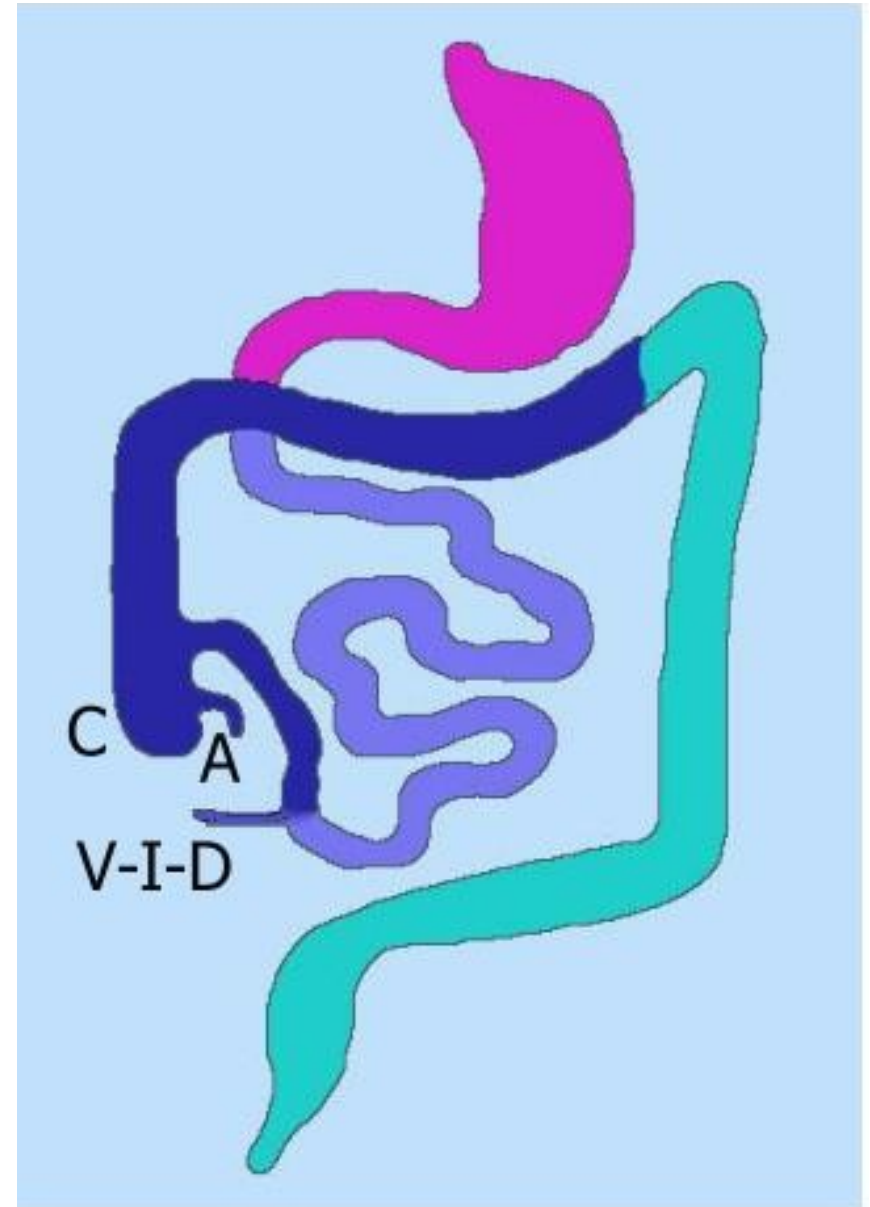
-At the end of this lecture, students should be able to:

- i. Describe the changes in the midgut loop.**
- ii. Discuss the physiological herniation, rotation & retraction of the midgut loop.**
- iii. Clarify fixation of the intestine.**
- iv. Explain how the alterations in normal midgut changes lead to congenital malformations.**
- vi. List the derivatives of hindgut.**
- vii. Describe the cloaca & its fate.**

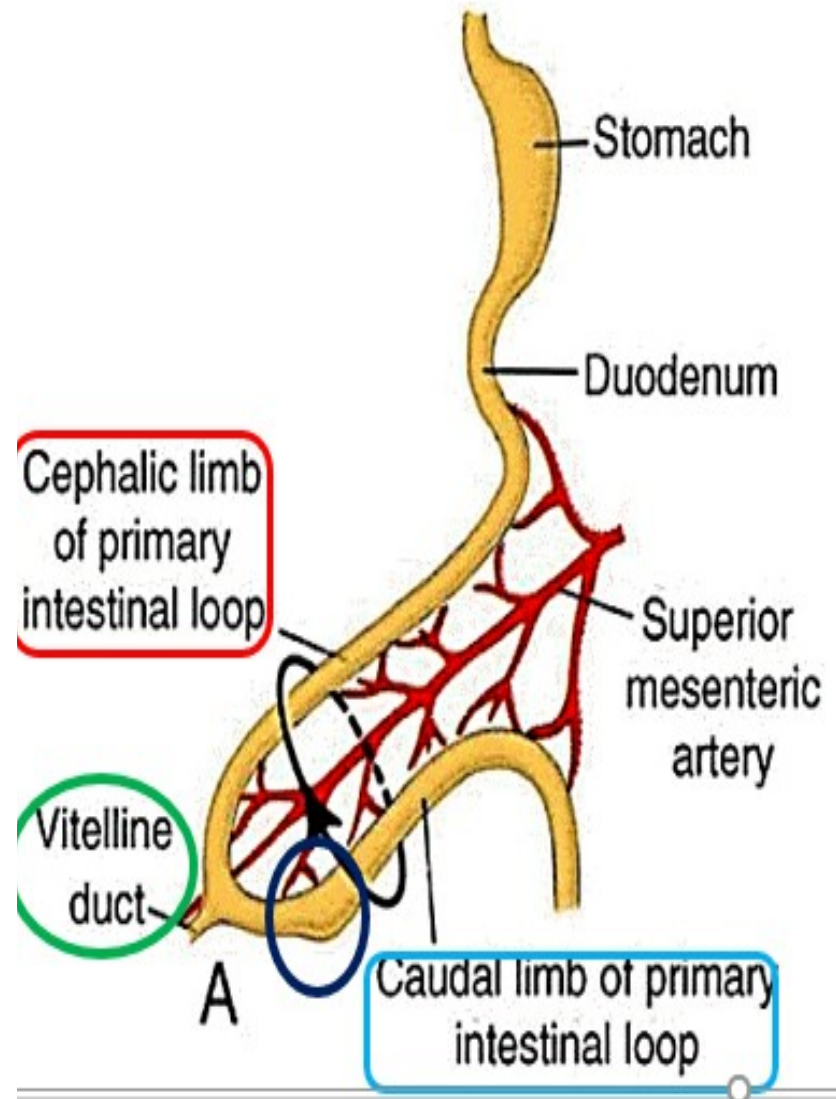
- ♣ **Development of the midgut:**

- Derivatives:**

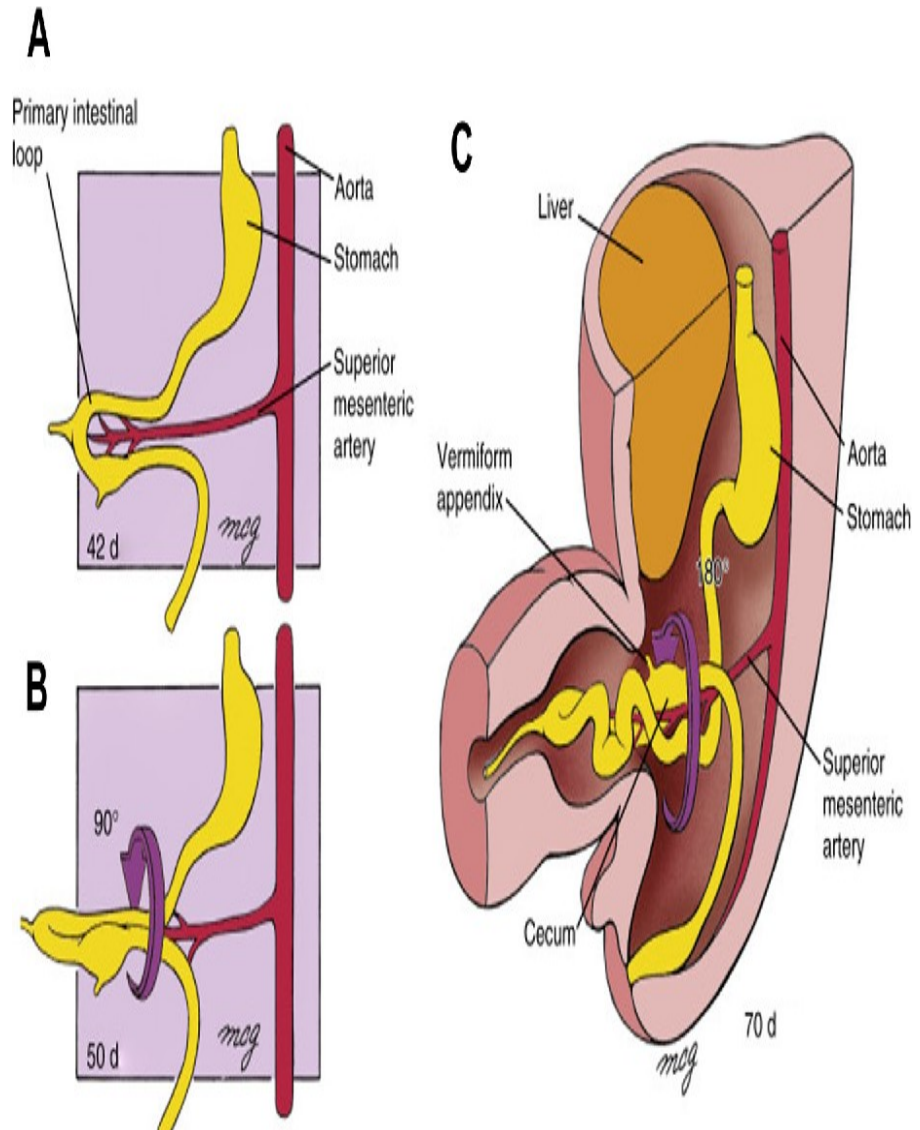
- 1- Caudal part of duodenum.
- 2- Jejunum.
- 3- Ileum.
- 4- Caecum.
- 5- Vermiform appendix.
- 6- Ascending colon.
- 7- Right 2/3 of transverse colon.
- All these derivatives are supplied by Superior mesenteric



- **Early appearance:**
- **The midgut (caudal to duodenum) forms a loop which is convex ventrally.**
- **The loop has a cranial and caudal limbs.**
- **The caecum appears as a bud in the beginning of the caudal limb.**
- **The loop has a mesentery containing the superior mesenteric artery.**
- **The Vitello-intestinal duct is connected to**



- **Changes in the mid gut loop:**
- **1- Elongation and coiling.**
- **2- Herniation and rotation:**
- **Elongation of the loop in the relatively small abdominal cavity and the enlarging liver causes herniation of the loop through the umbilicus to the umbilical cord in the 6th week.**



- **Reduction of the hernia:**

(In the 10th week)

- **Causes:**

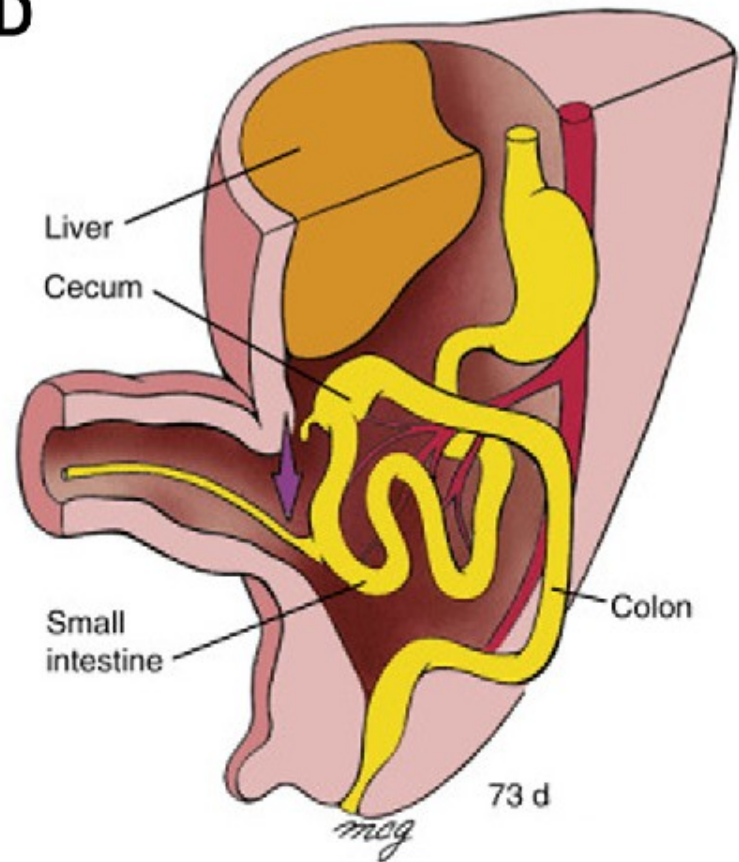
- 1- **Widening of the abdominal cavity.**

- 2- **The liver becomes relatively smaller.**

- 3- **a fibro- muscular band around superior mesenteric artery contracts.**

- 4- **The longitudinal muscle layer of the**

D



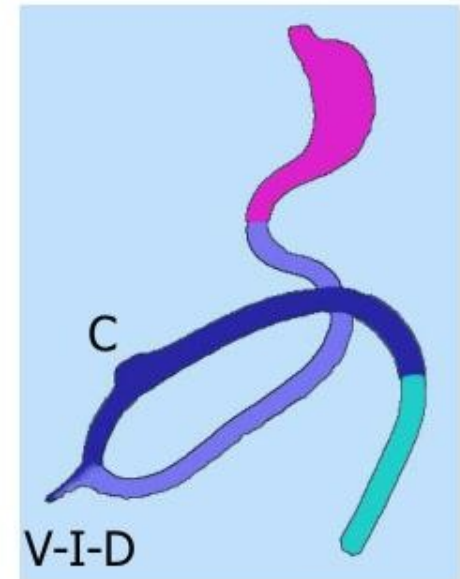
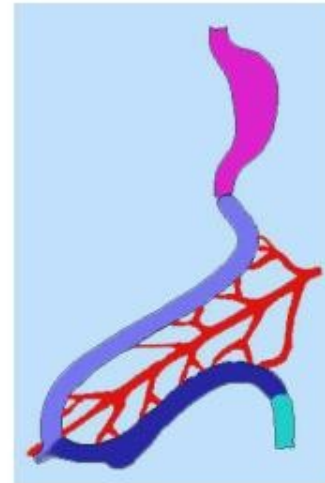
- **A second rotation 180° anti-clockwise occurs during reduction of the midgut loop.**

= (Total 170° rotation)

- **As a result:**

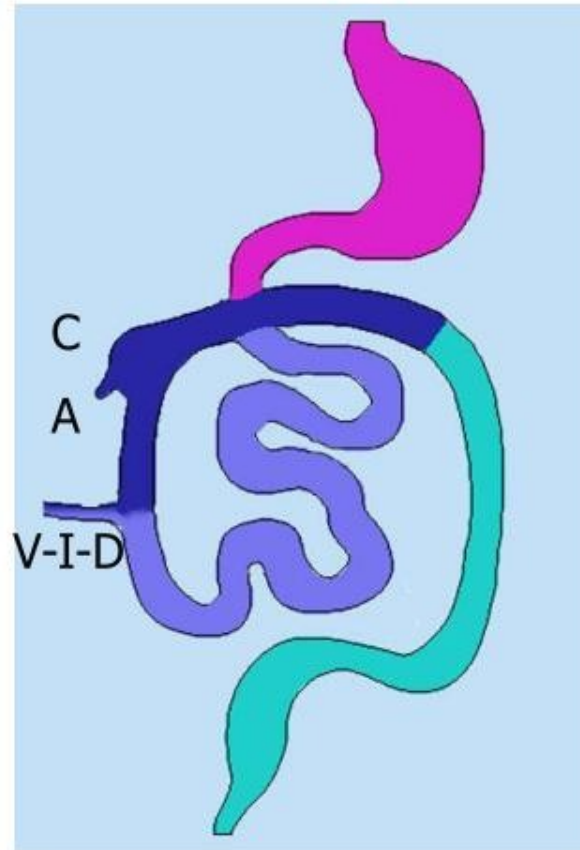
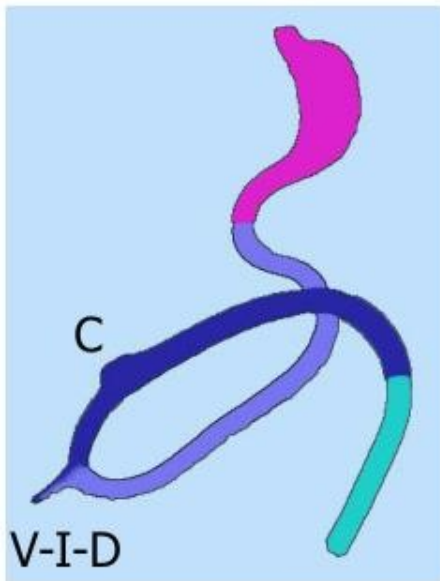
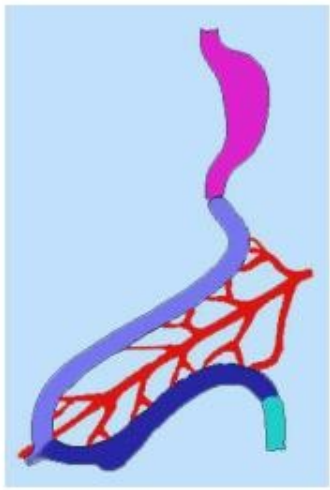
- 1- **The superior mesenteric artery crosses in front of the 3rd part of duodenum.**

- 2- **Transverse colon crosses in front of the 2nd part of**

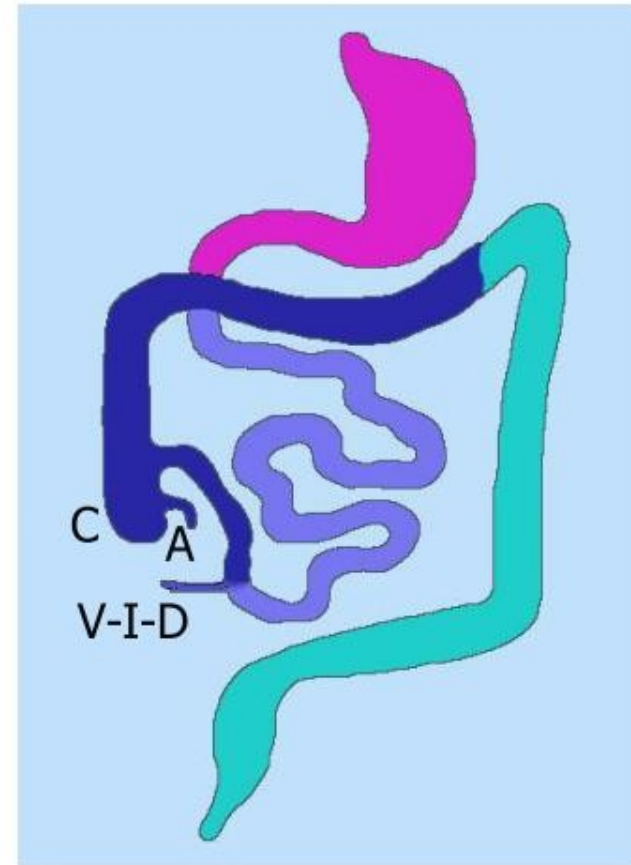


Rotation – Midgut

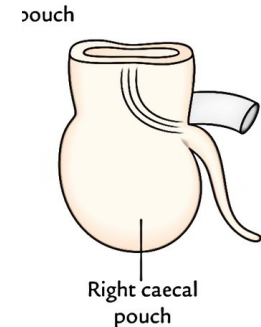
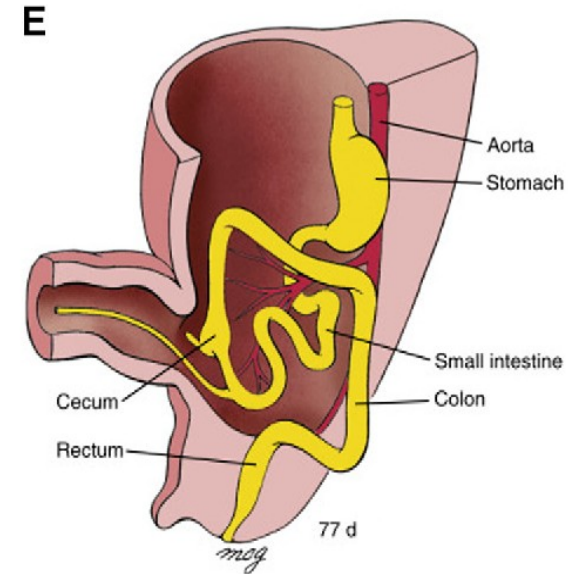
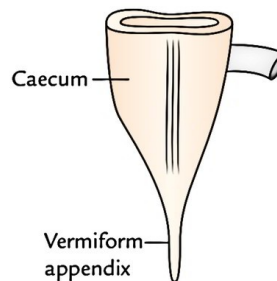
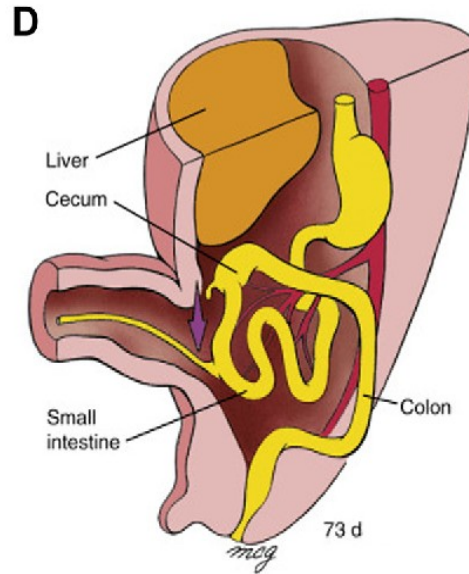
Also note hindgut derivatives



C : caecum
A : appendix
V-I-D : vitellointestinal duct

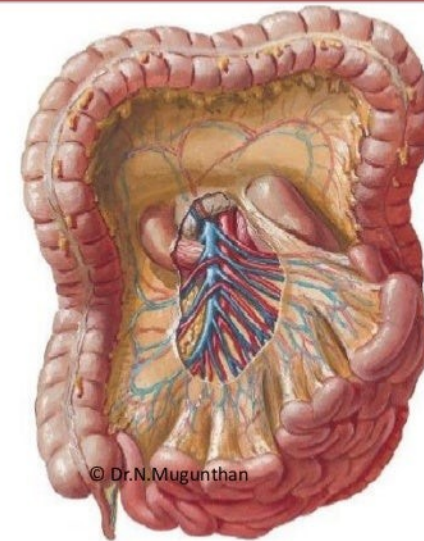


- The caecal bud at first occupies a subhepatic position.
- Later, it descends to the right iliac fossa with elongation of the ascending colon.
- At first, the caecum is conical in shape and the appendix grows from its apex. Later, unequal growth of the caecal walls brings the opening of the appendix to the posteromedial



- **Obliteration of the vitello- intestinal duct occurs.**
- **Absorption of the dorsal mesentry occurs in the region of the ascending colon which becomes retroperitoneal.**
- **The remaining parts of the dorsal mesentry form the mesentry of small intestine, mesoappendix and transverse**

MESENTERY



Anomalies of midgut:

A]Midgut hernia: 3 types;

1. Congenital umbilical hernia:

-The intestine herniates through an imperfectly closed umbilicus → A swelling which passes through the umbilicus & covered by skin.



2. Congenital omphalocele:

.It is a persistence of herniation of the intestine into the umbilical cord → Formation of a swelling which is covered only by the amnion.

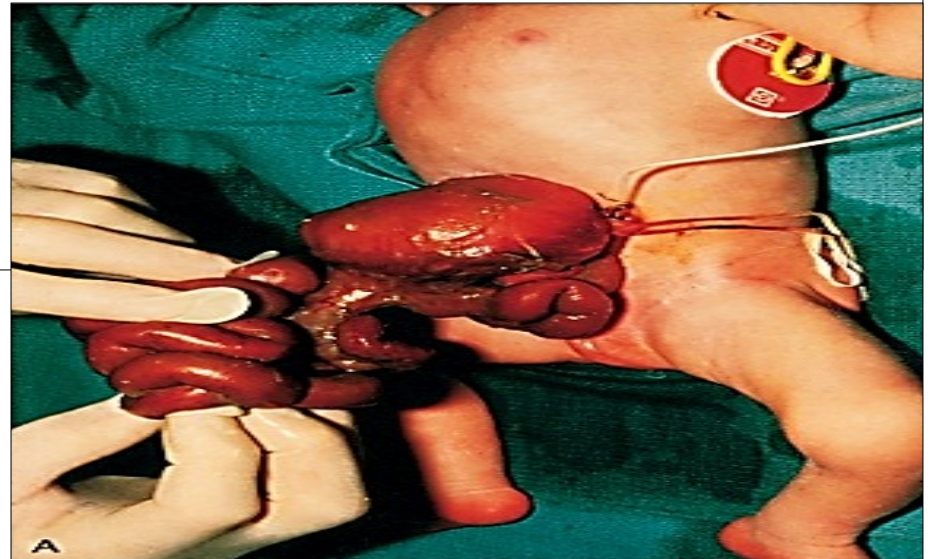
.This condition is associated with a high mortality rate (25%).



3. Gastroschisis :

results from a defect in the anterior abdominal wall → The viscera protrude into the amniotic cavity.

.It results from incomplete closure of the lateral folds during 4th week of development.

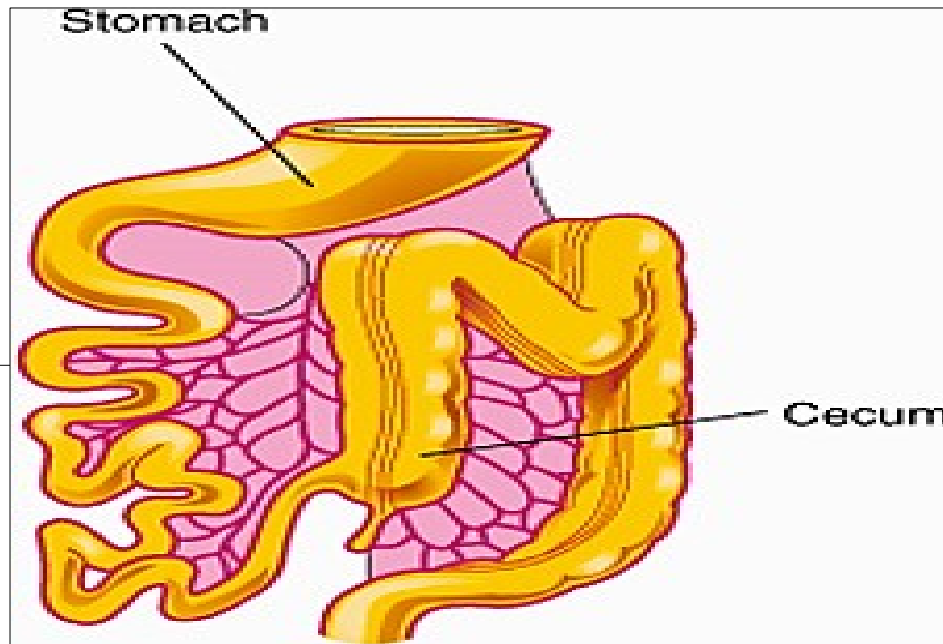


Gastroschisis

B] Abnormal rotation of the midgut loop:

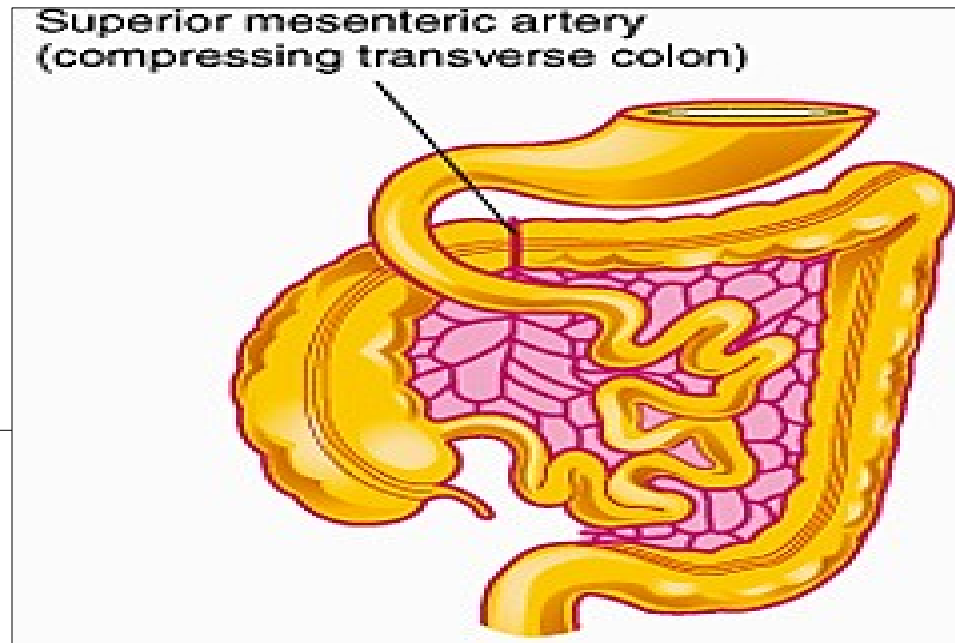
1. Non-rotation of the midgut: → Left-sided colon.

Large intestine (colon) lies on left side & small intestine lies on right side of the abdomen.



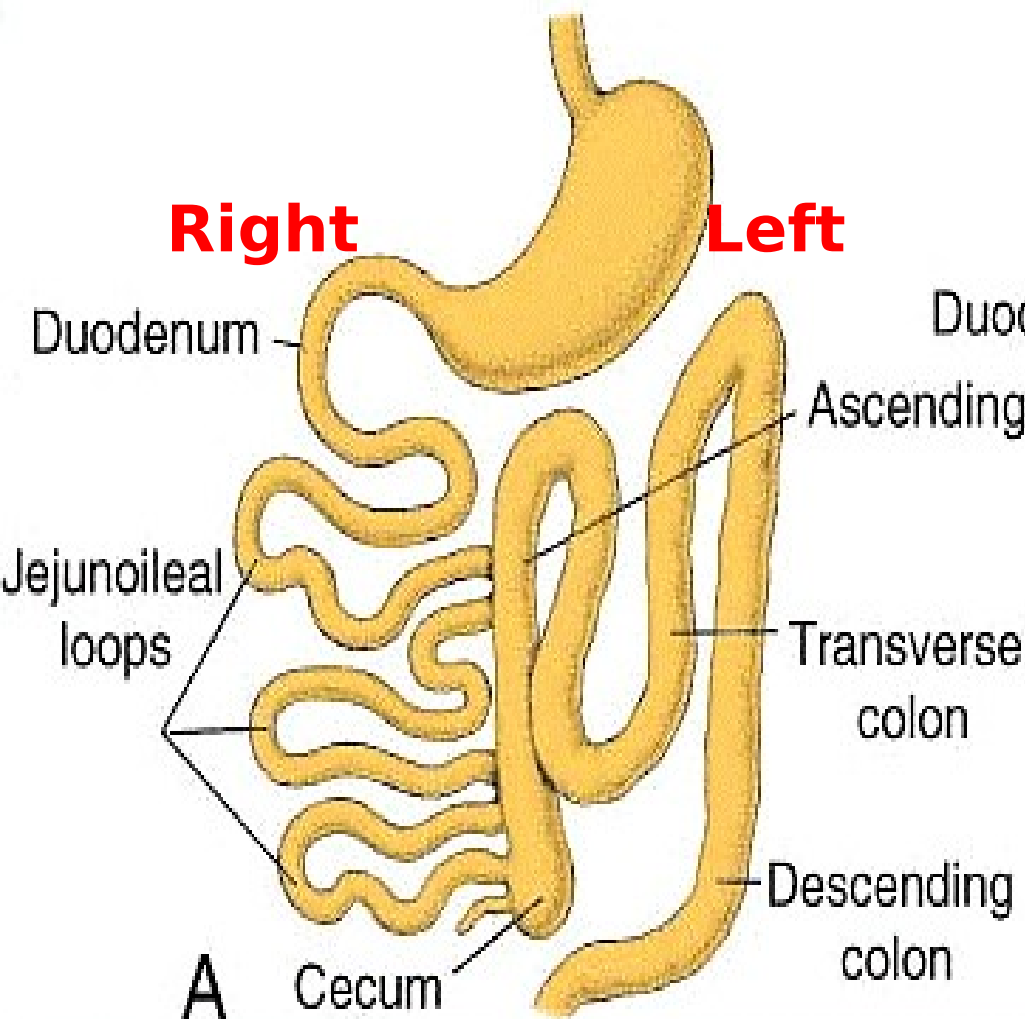
2. Reversed rotation of the midgut:

**.Midgut loop rotates in a clockwise direction →
The transverse colon lies posterior to the
duodenum & the superior mesenteric artery →
Obstruction of the transverse colon.**

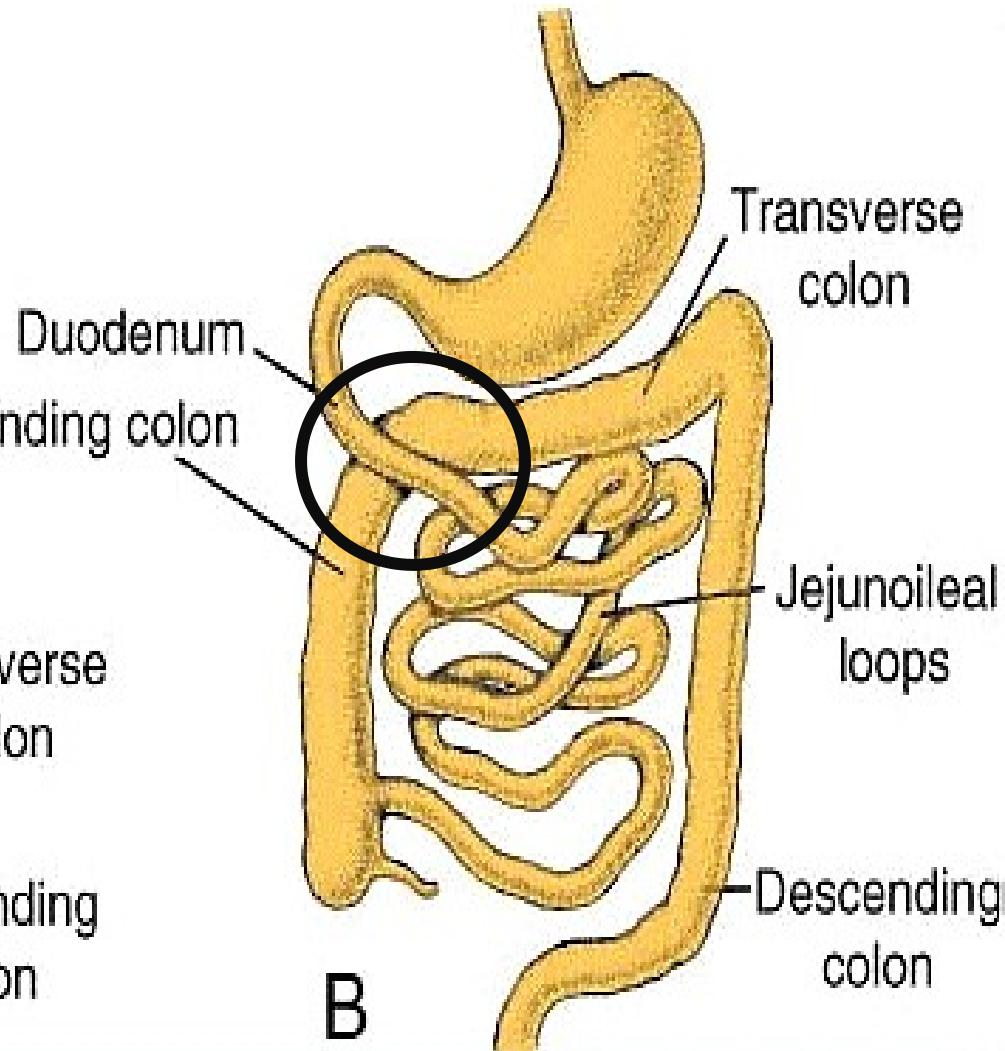


Abnormal rotation of the midgut loop

Non-rotation
(**left-sided colon**)

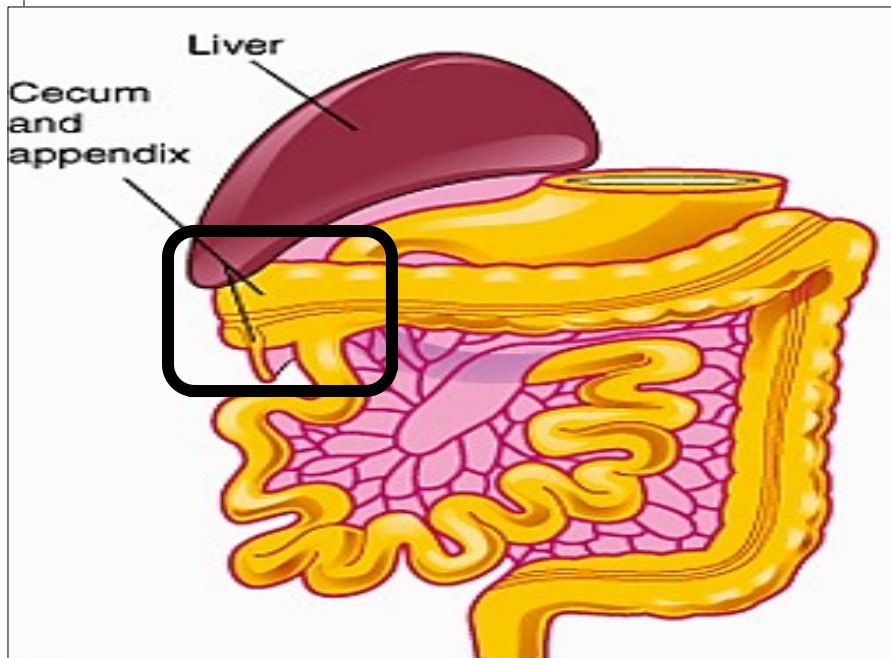


Reversed rotation
(**retroduodenal transverse col**)

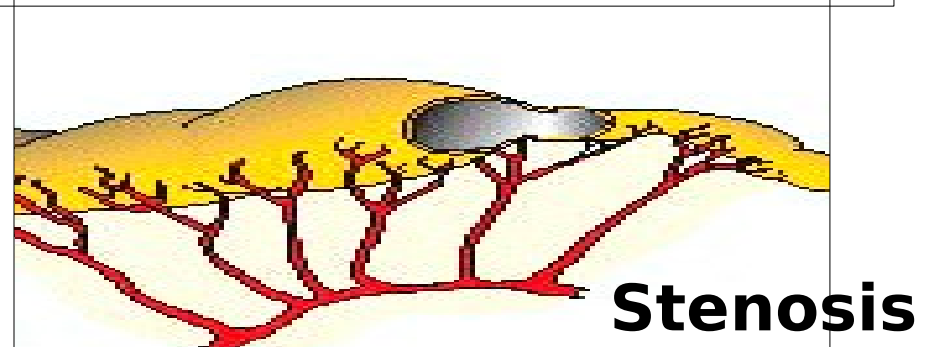
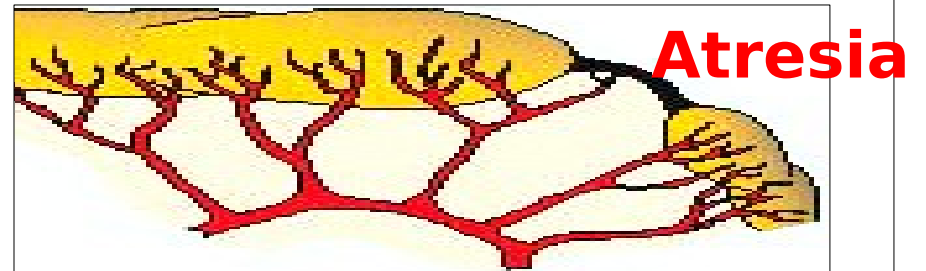


C] Subhepatic cecum :

-It is due to failure of down growth of the cecum → Absence of the ascending colon.



D] Stenosis & atresia of the intestine:
Narrowing (stenosis) or absence (atresia) of the intestinal lumen may occur → Intestinal obstruction.

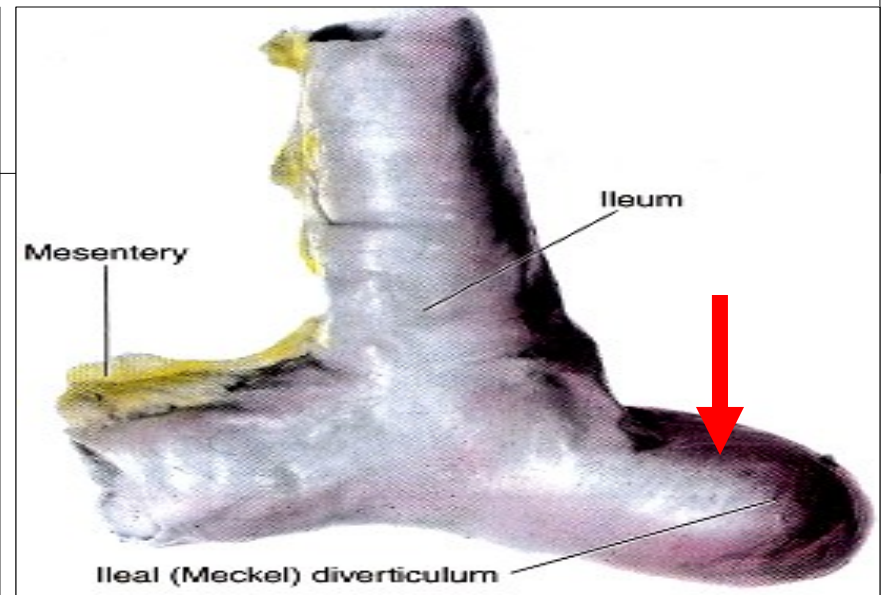
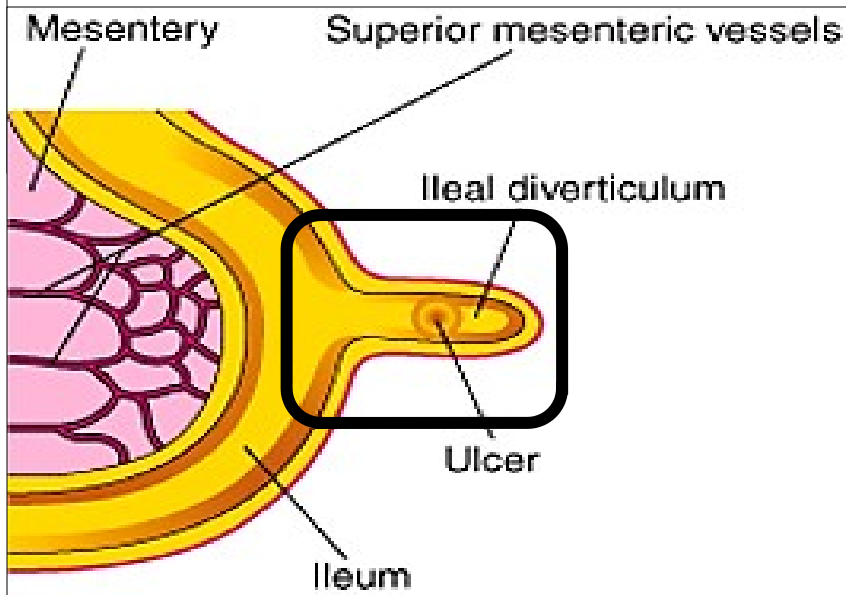


E] Remnants of the vitelline duct:

1. Meckel's diverticulum:

.This is a fingerlike pouch in 2% of people, 2 inches long, 2 feet (60 cm) from ileocecal junction.

.It has a clinical significance because it may be inflamed & causes symptoms that mimic appendicitis.



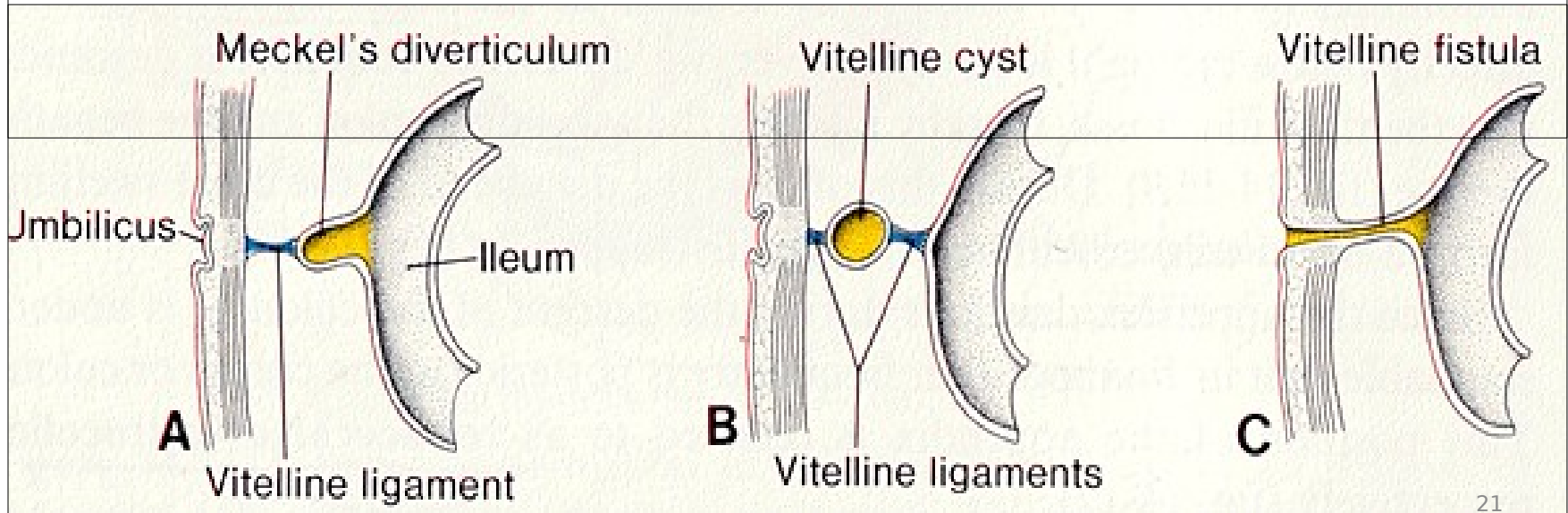
2. Other remnants of vitelline duct include:

.Vitelline ligament: A fibrous band connecting the midgut to the umbilicus due to failure of degeneration of the fibrosed duct [*Volvulus?*].

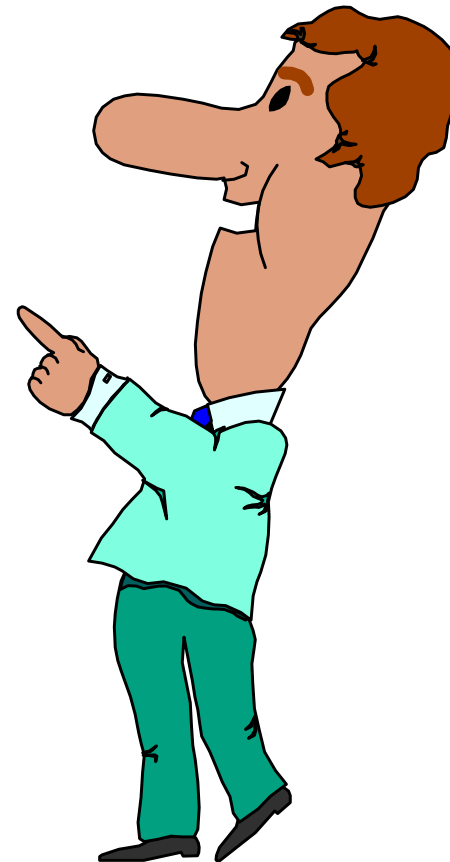
.Vitelline cyst: Cystic swelling in vitelline ligament.

.Vitelline fistula (fecal fistula):

-The duct remains patent & conducts fecal matter from the intestine to the umbilicus.



QUIZ



Regarding the development of midgut loop:
a. Midgut loop rotates 270° in a clockwise direction during 6th - 10th week of development.

b. Cranial limb of midgut loop gives rise to large intestine up to the posterior intestinal portal.

c. During reduction (return) of the physiological umbilical hernia, jejunum re-enter the abdomen first, so come to lie on left side.

d. Gastroschisis has a better prognosis than omphalocele.

e. Transverse colon passes anterior to 2nd part of the duodenum as a result of reversed rotation of the midgut loop.

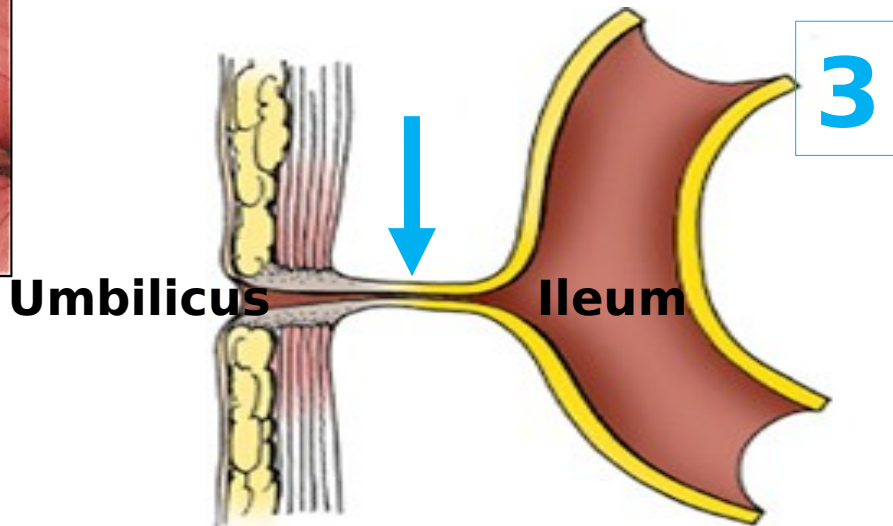
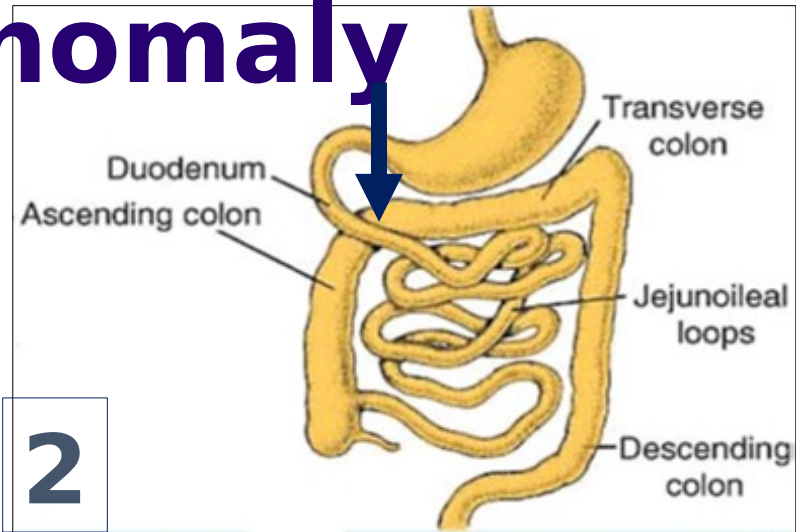
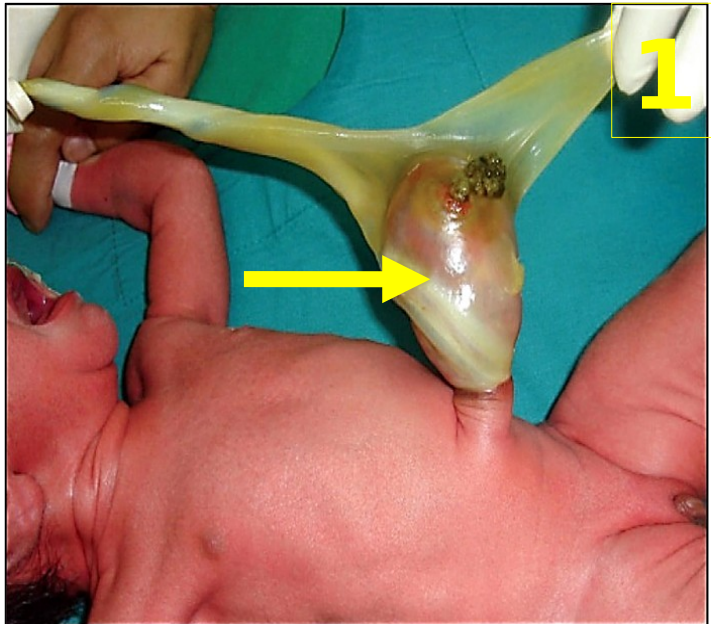
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■ Mention the congenital anomaly resulting from:

Non rotation of midgut - Failure of return of



Identify the anomaly



Hindgut

Derivatives of hindgut:

A- Mucosal lining of:

1- Left 1/3 of transverse colon.

Descending colon.

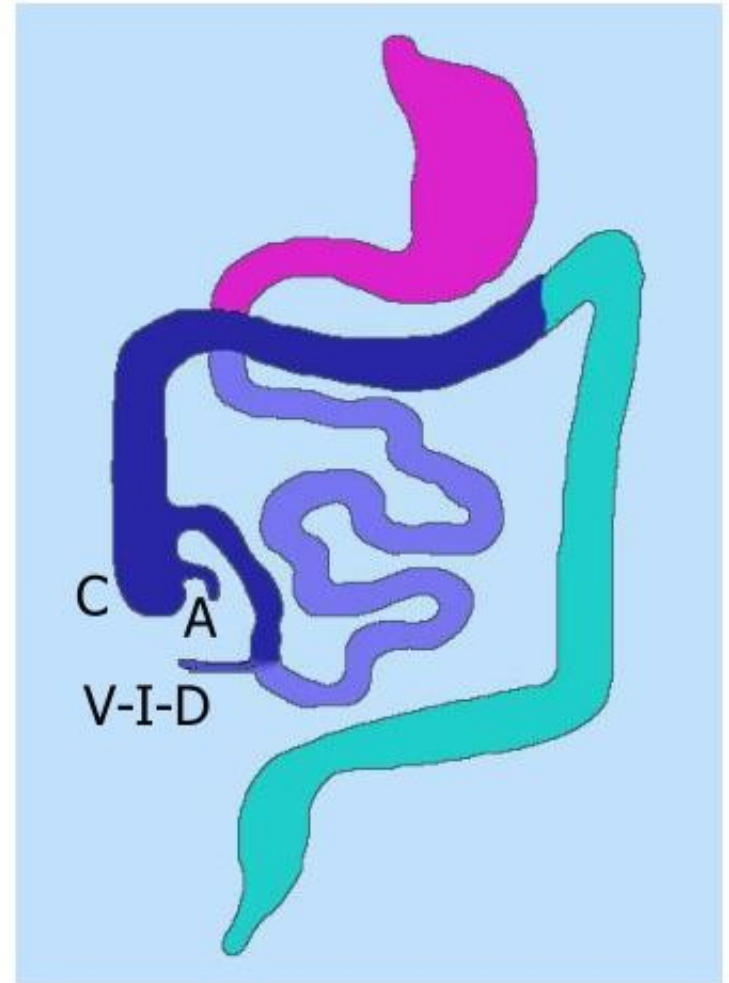
Sigmoid colon.

Rectum.

Upper part of anal canal.

All of them are supplied by Inferior Mesenteric artery.

B- Lining parts of the urogenital system



Hindgut

The hindgut is formed of 2 Parts:

1-The proximal part:

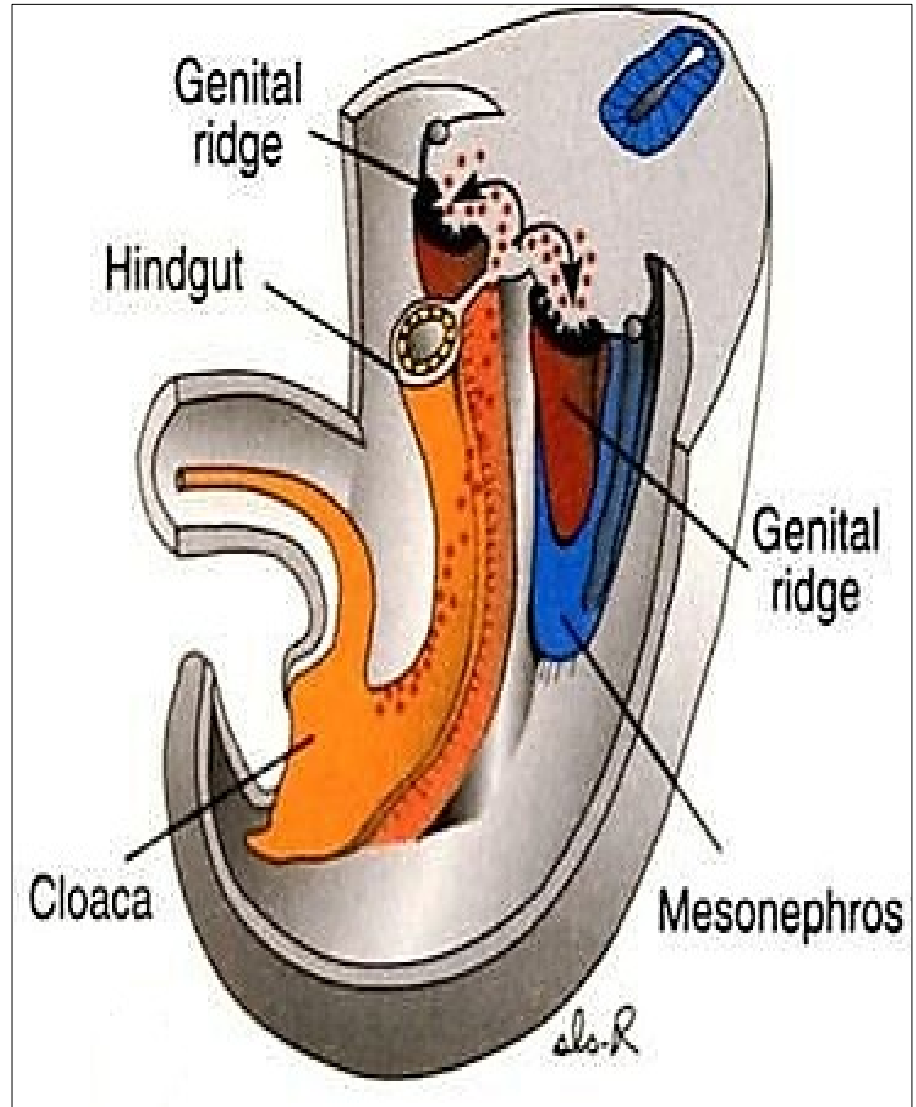
It will give:-

1- left 1/3 of transverse colon.

2- Descending colon.

3- Sigmoid colon.

The descending mesocolon will be absorbed and The descending colon becomes retroperitoneal.

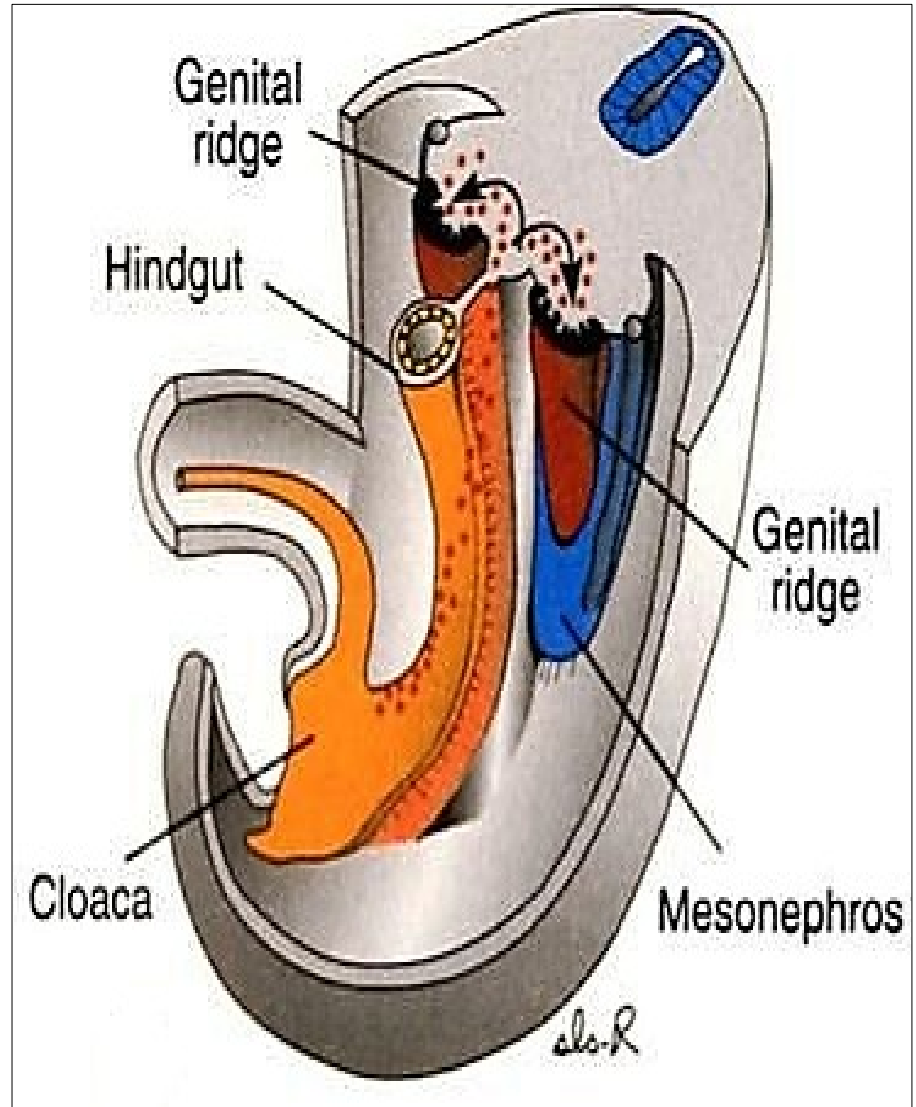


Hindgut

The hindgut is formed of 2 Parts:

2-The distal part (caudal to allantois):

It is formed of the cloaca which is dilated and receives the allantois ventrally. Its caudal end is closed by cloacal membrane.



Hindgut

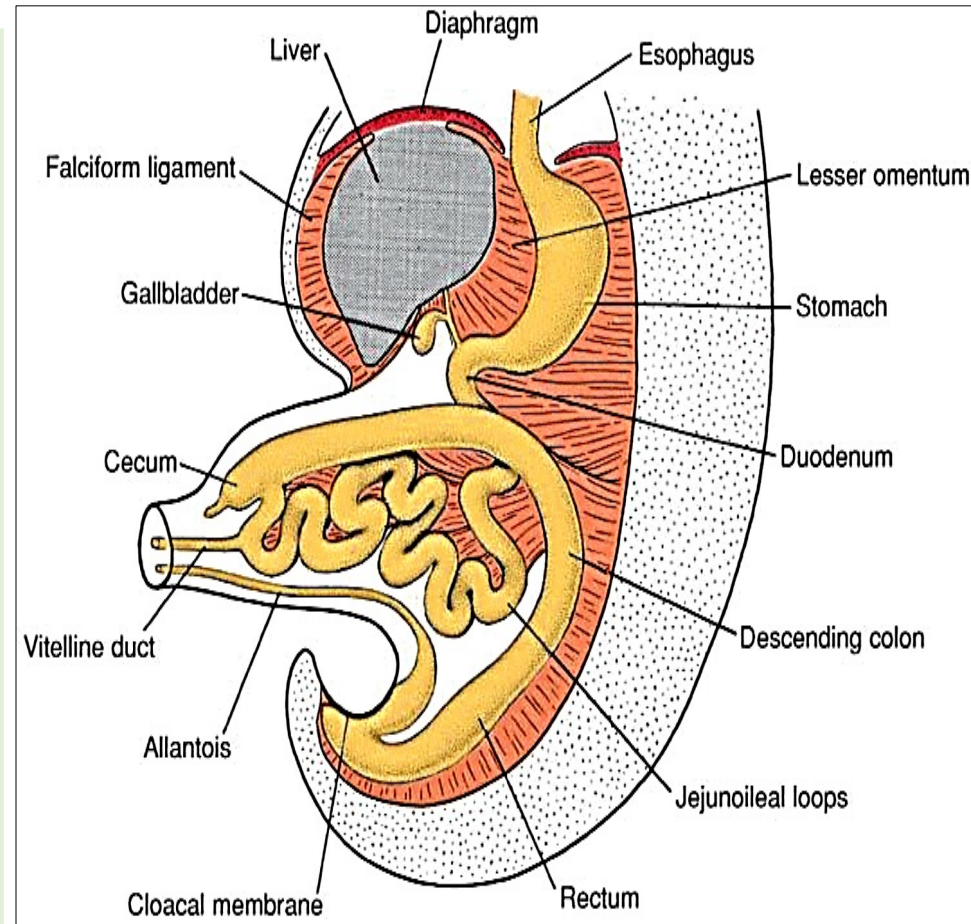
A coronal partition is formed called **uro-rectal septum**.

As a result:

A- The cloaca becomes divided into:

1- Ventral part (**primitive urogenital sinus**) □ parts of urogenital system.

2- Dorsal part □ The mucosa of rectum and upper part of anal canal.



Hindgut

The cloacal membrane becomes divided into:

1- ventral part:

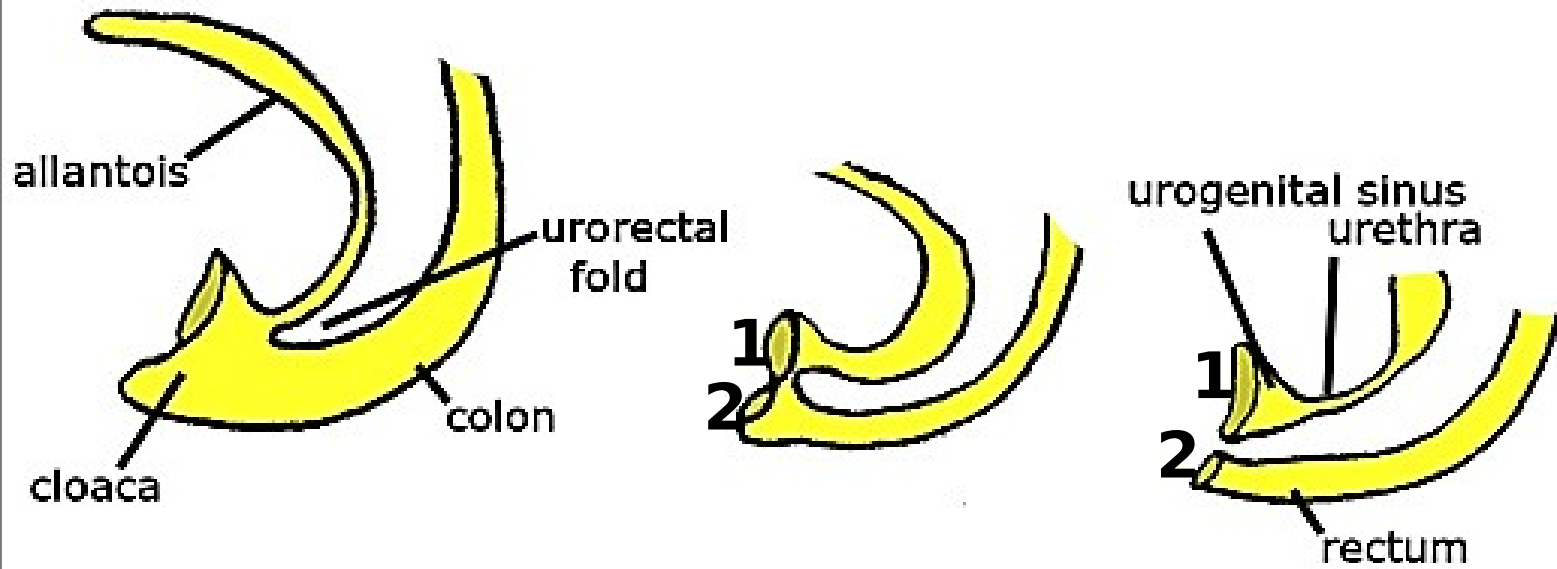
Called **urogenital membrane** (1).

2- Dorsal part:

Called **anal membrane** (2).

The site of fusion between the uro-rectal septum and the cloacal membrane corresponds to

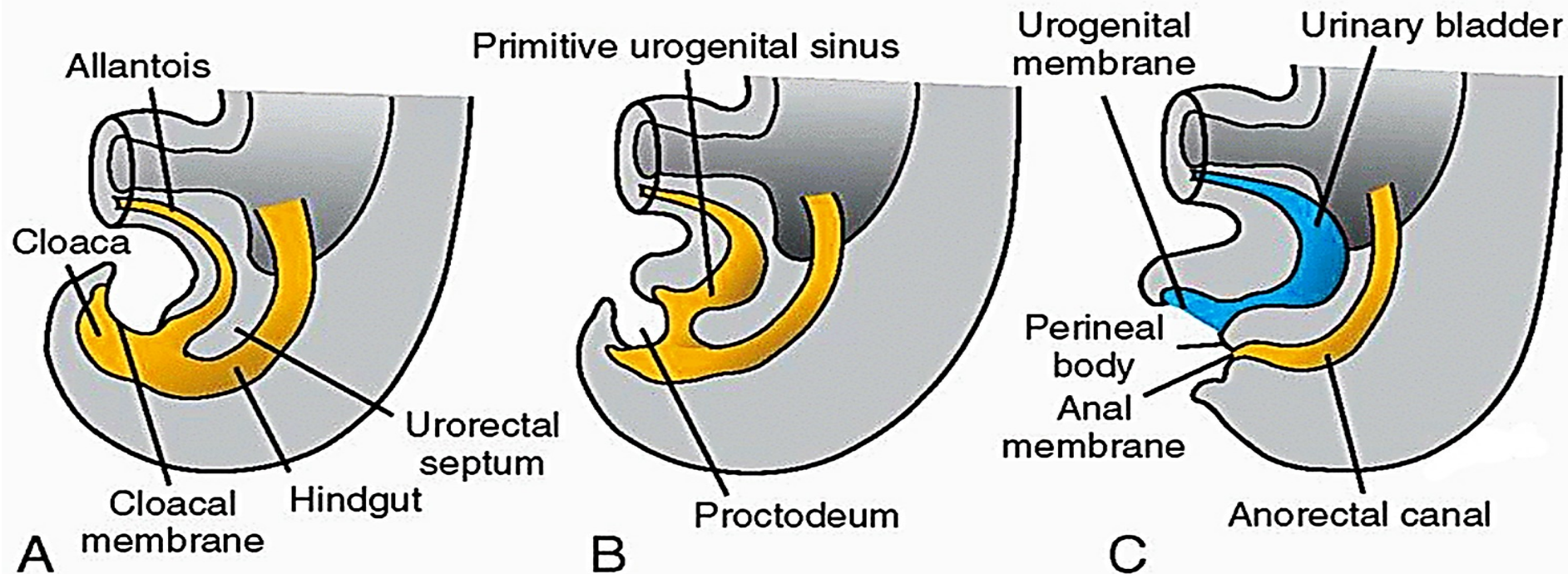
Progression of the urorectal fold to divide the cloaca



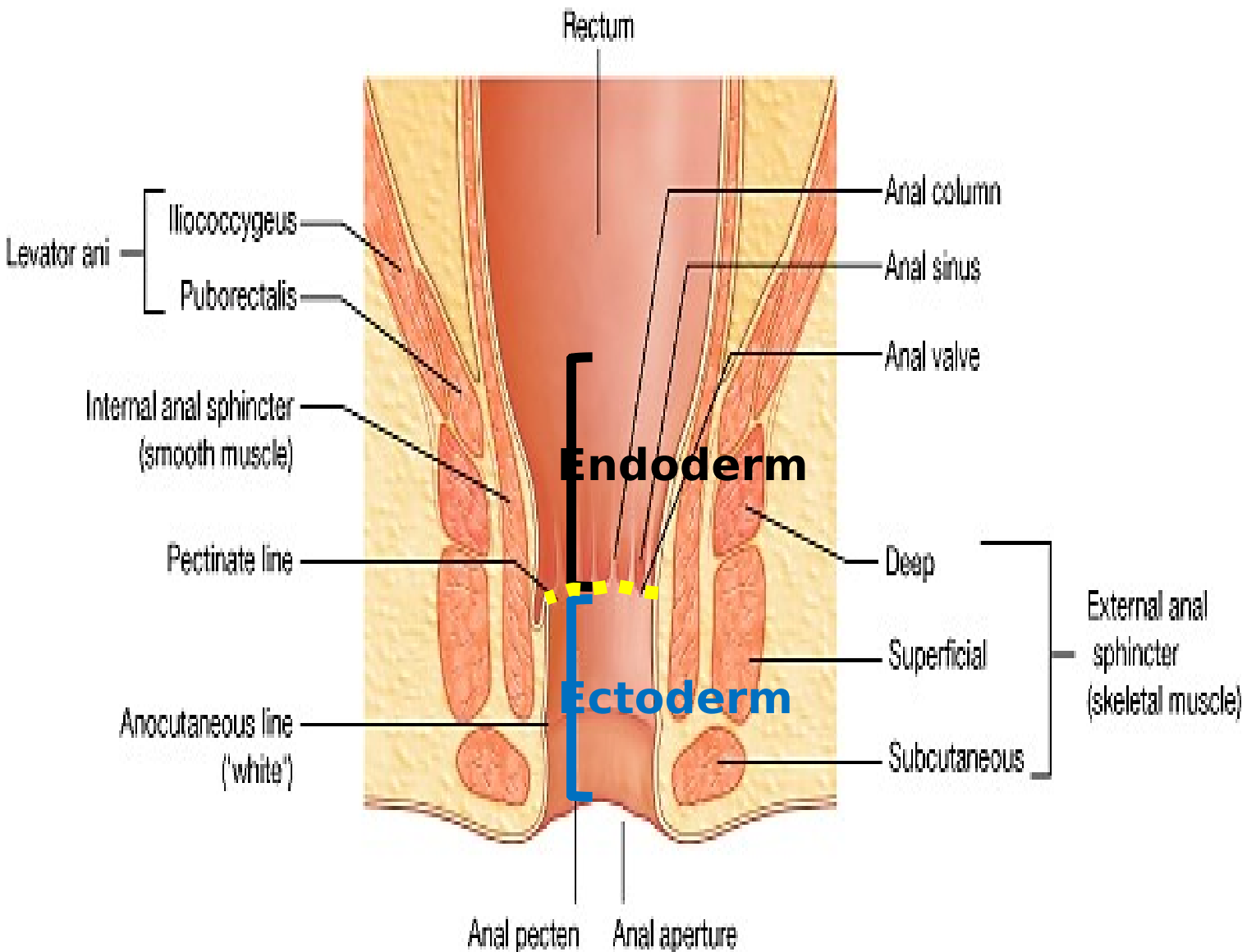
-The mesoderm around the anal membrane proliferates and surrounds an ectodermal depression called **proctodeum**.

-The anal membrane will rupture at the 9th week and the proctodeum will form the lower part of the anal canal.

-The junction between the endodermal & the ectodermal parts of the anal canal (site of the



Anal canal



Note
that

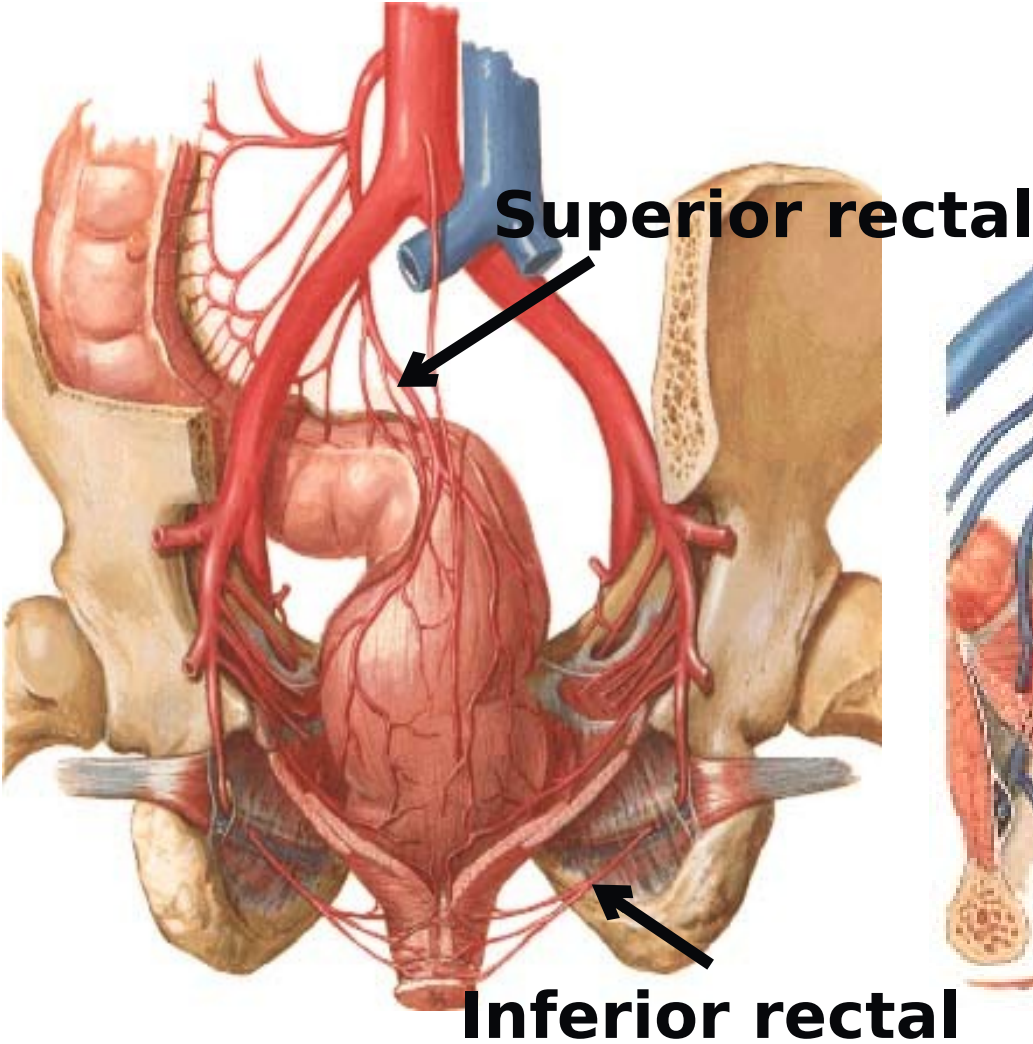


♣ Because of its hindgut origin, upper part of the anal canal is supplied by **superior rectal artery**, the continuation of inferior mesenteric artery (artery of the hindgut), drained by the portal circulation & innervated by autonomic nerves (insensitive to pain, touch & pressure).

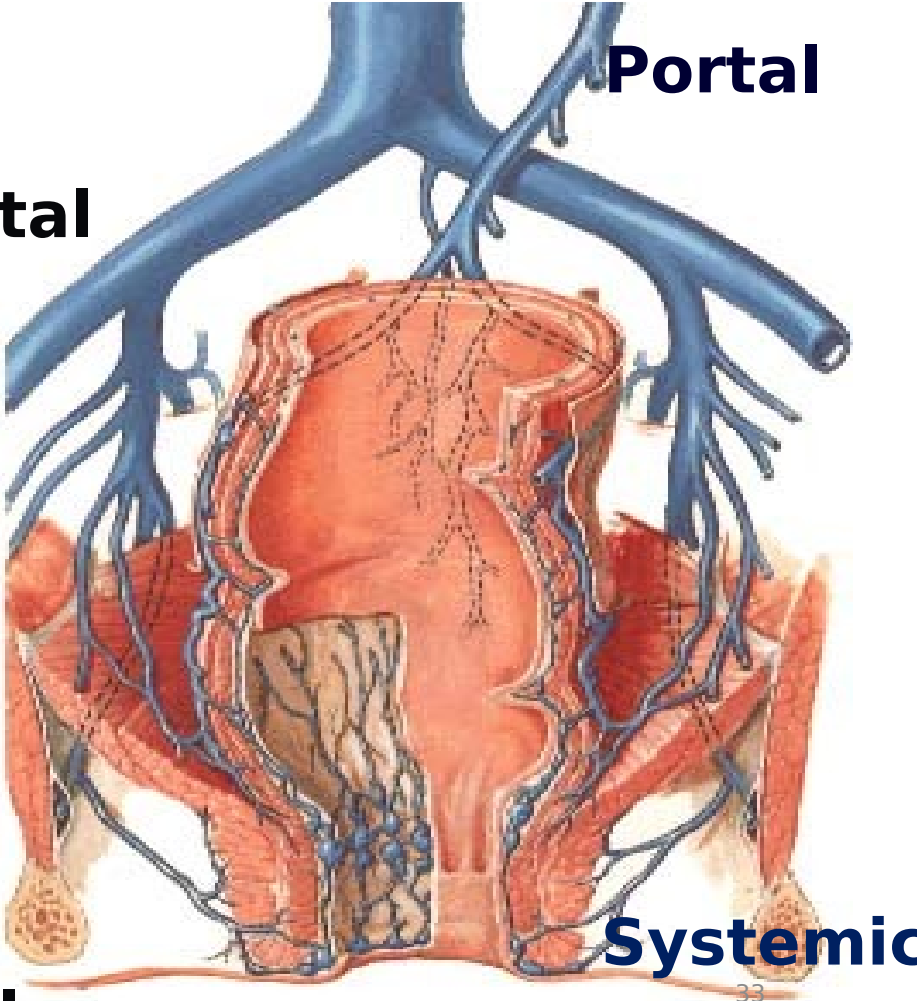
♦ Lower part of anal canal (from the proctodeum) is supplied by **inferior rectal arteries**, drained by systemic venous circulation & innervated by somatic nerves (inferior rectal nerves), thus it is sensitive to pain, touch & pressure.

Blood supply of anal canal

Arterial



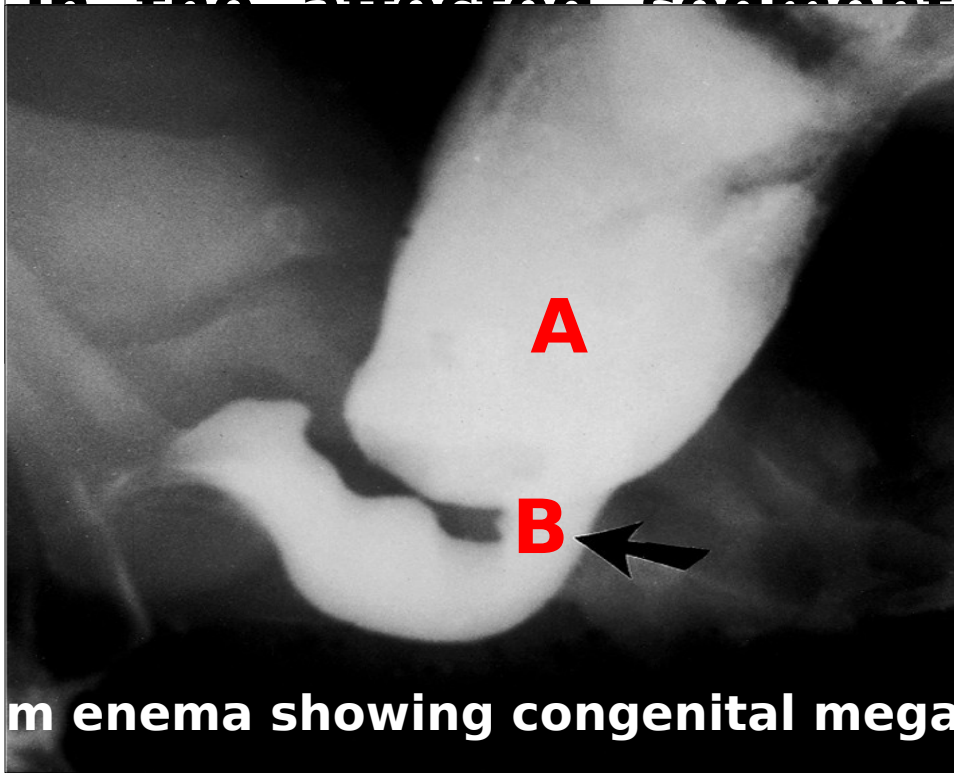
Venous



♣ **Anomalies of hindgut:**

1. Congenital megacolon [Hirschsprung disease]:

-Failure of migration of neural crest cells into the wall of the affected segment → Absence of the autonomic plexuses → Failure of peristalsis in the affected segment → Dilatation of the affected segment.

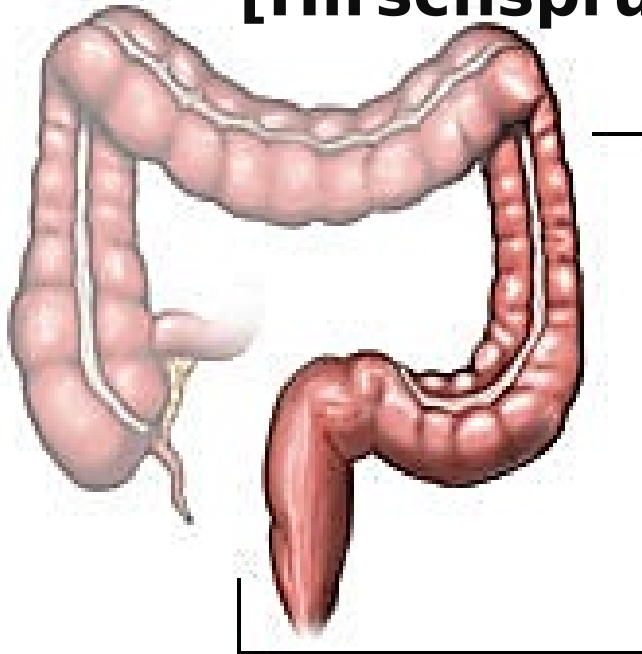


A → Normal dilated segment

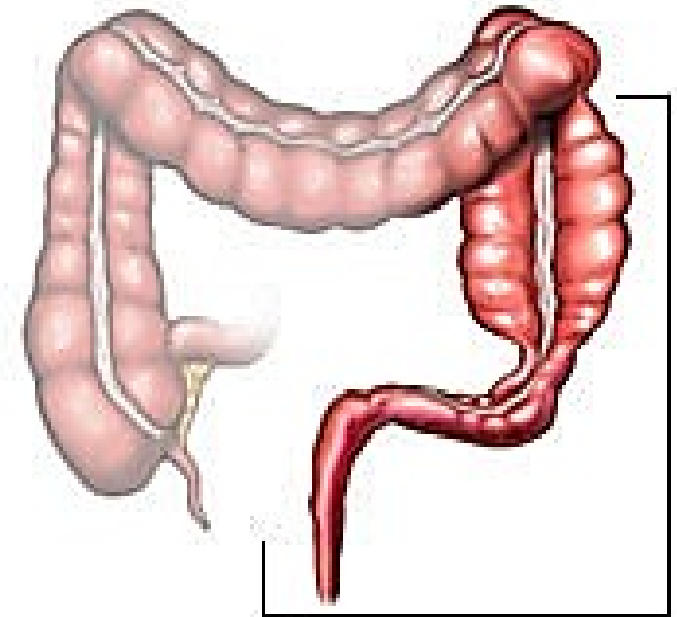
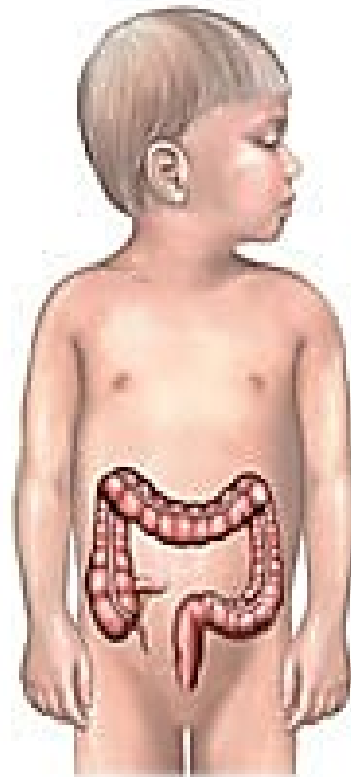
B → Narrow aganglionic segment

m enema showing congenital mega

Congenital megacolon **[Hirschsprung disease]**

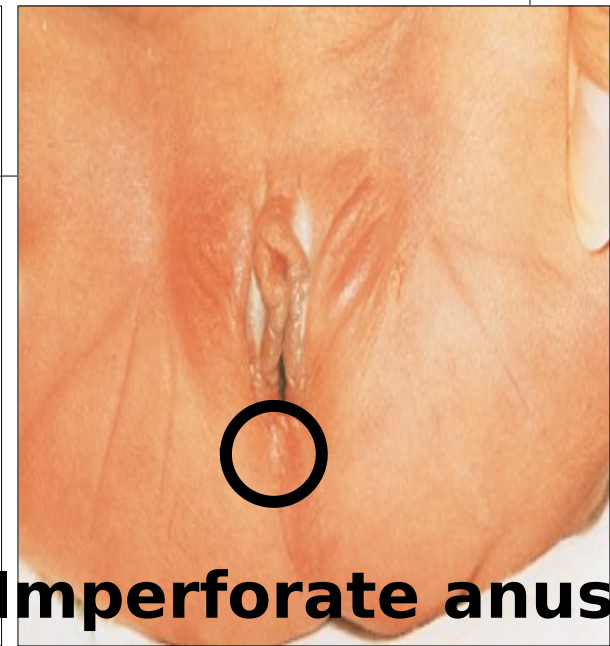
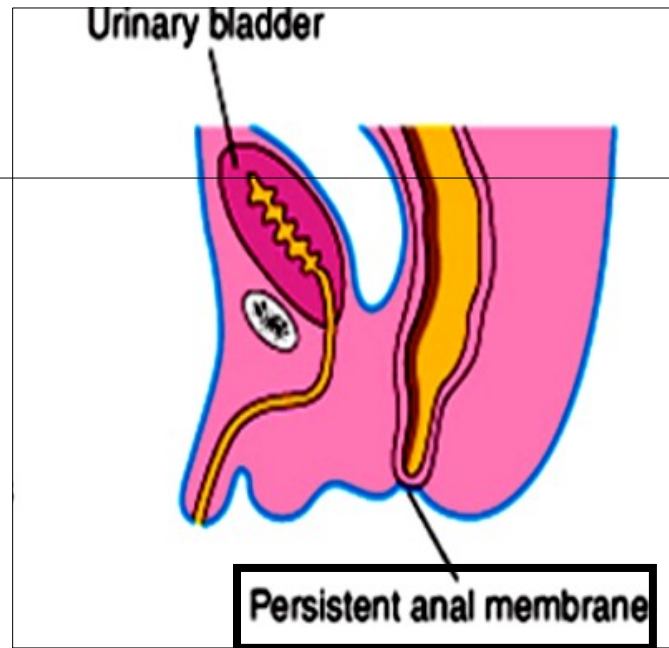


Normal sigmoid
colon and rectum

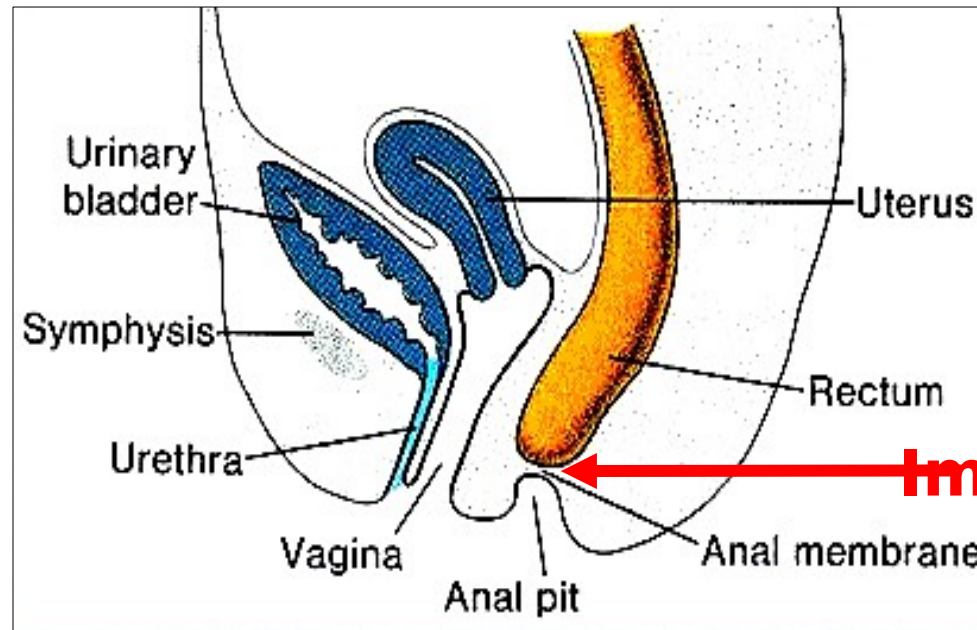


Swollen colon from
Hirschsprung's disease

2. Imperforate anus: Due to failure of the anal membrane to rupture at the end of 8th week.



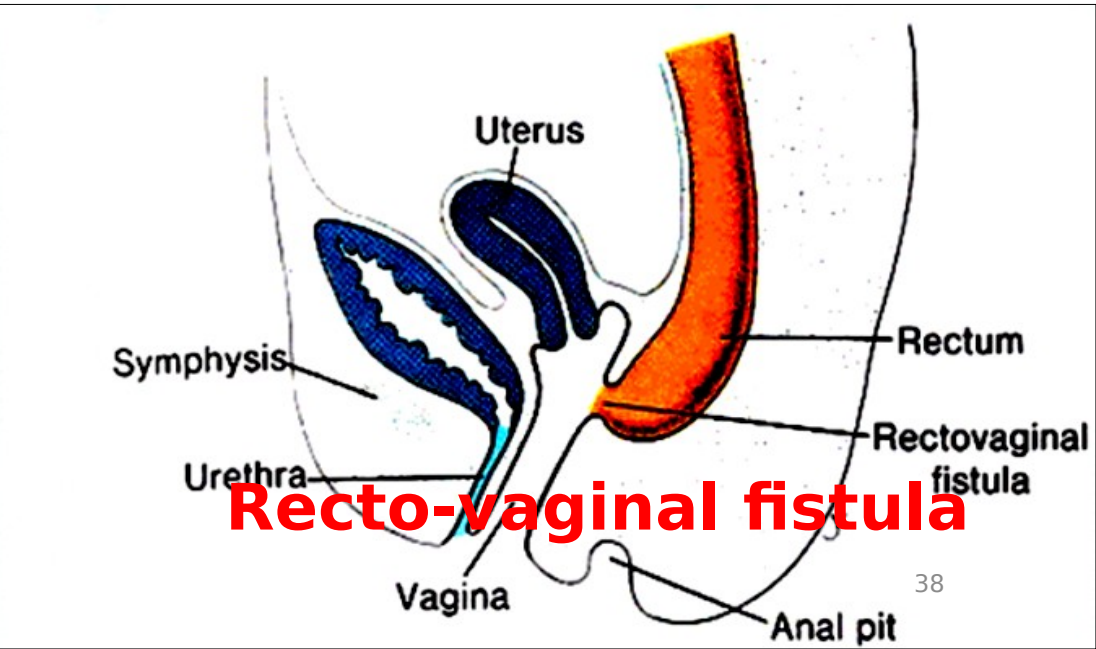
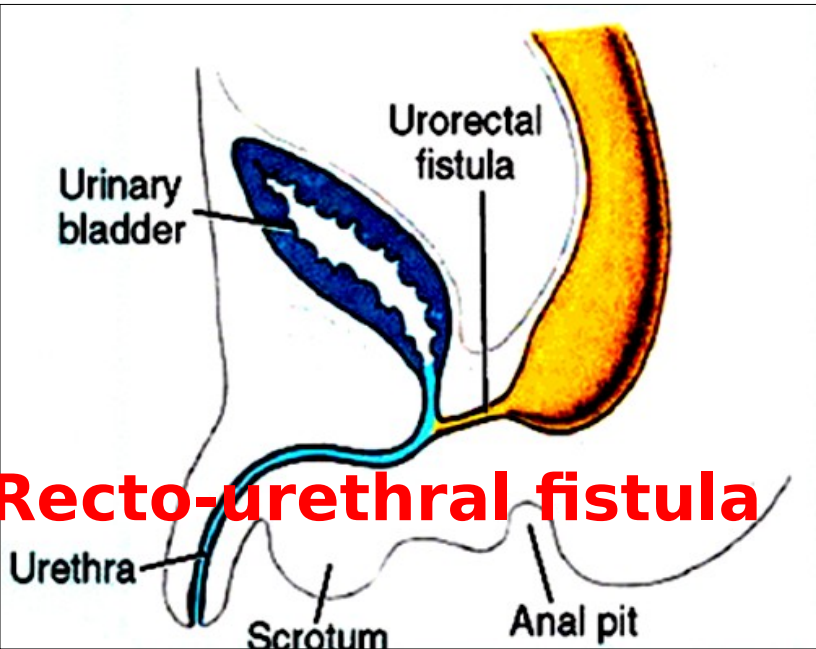
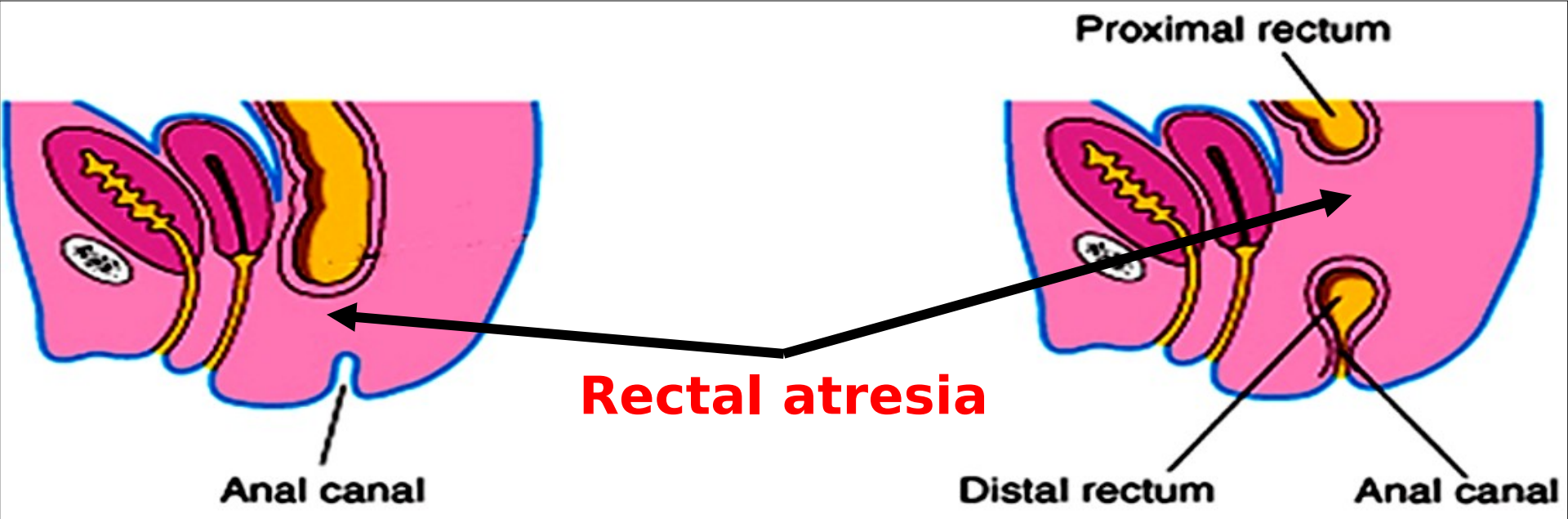
Imperforate anus



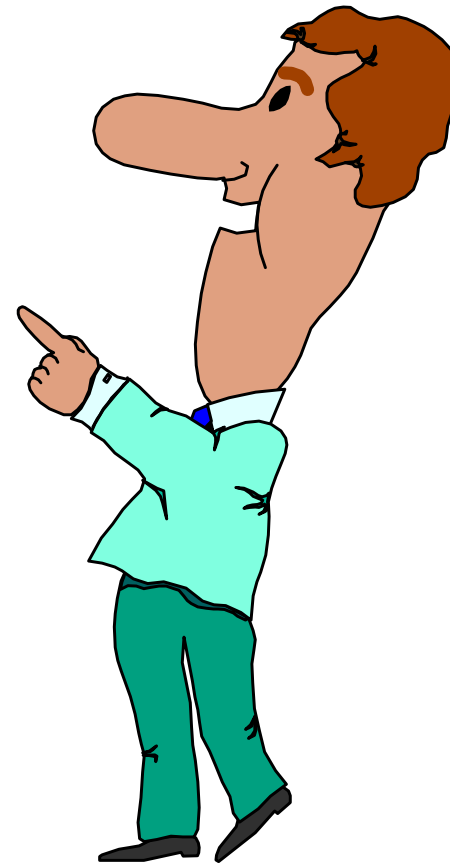
3. Rectal atresia & rectal fistula: Due to abnormal development of the urorectal septum.

-Fistula may be: Recto-vaginal in females & recto-vesical (with the bladder) or recto-urethral (with the urethra) in males.

High anorectal anomalies



QUIZ



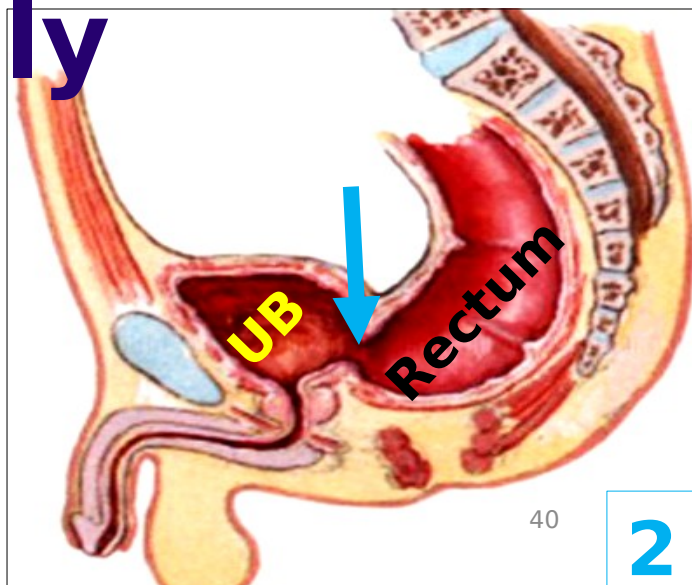
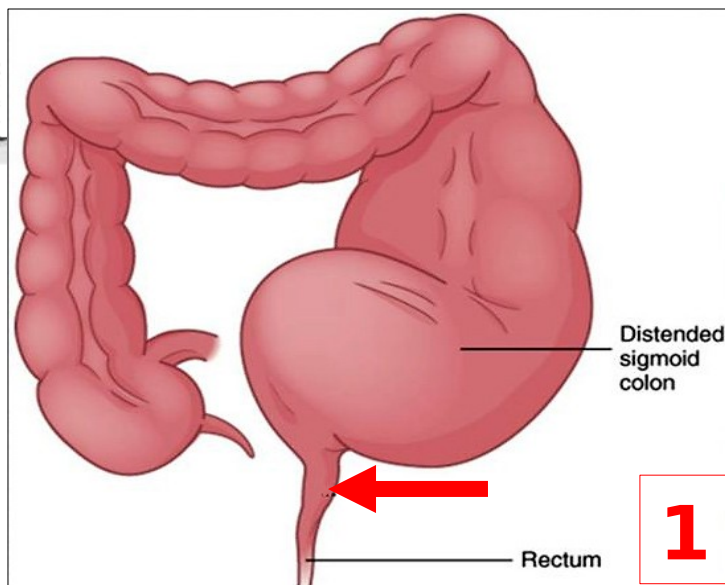
■Mention the congenital anomaly (s) resulting from:

Failure of migration of neural crest cells into the wall of the colon - Failure of rupture of anal membrane - Posterior displacement of urorectal septum.

■List the derivatives of the cloaca?

■Mention the structure developed at the area of meeting of the urorectal septum & cloacal membrane

Identify the



References

- 1.Keith L. Moore: Before we are born, essentials of embryology and birth defects; 7th edition.**
- 2.Langman: Medical embryology; 11th edition.**
- 3.Web site:
www.studentconsult.com**

GOOD LUCK